HOBART'S FLOATING BRIDGE

Nomination for a

Heritage Recognition Award

Anonymous

Bridge in service; lift span far left

Prepared by Bruce Cole

for

Engineering Heritage Tasmania

Version 2

April 2014

CONTENTS

INTRODUCTION

The wide Derwent Estuary formed a natural barrier between Hobart on the western shore and the growing settlements and farms to the east. Crossings depended on a vehicular and passenger ferries but there was a growing need for easier access. Many different designs for bridging the estuary had been suggested and abandoned over the years.

At last in 1936 Alan Knight, Chief Engineer of the Public Works Department, proposed a curved floating concrete bridge with a lift span for shipping as a feasible and economic solution. The Hobart Bridge Company obtained Government approval in 1936 and financed the project, hoping to profit from land appreciation on the eastern shore. Construction began in April 1938 and the bridge opened for traffic in December 1943.

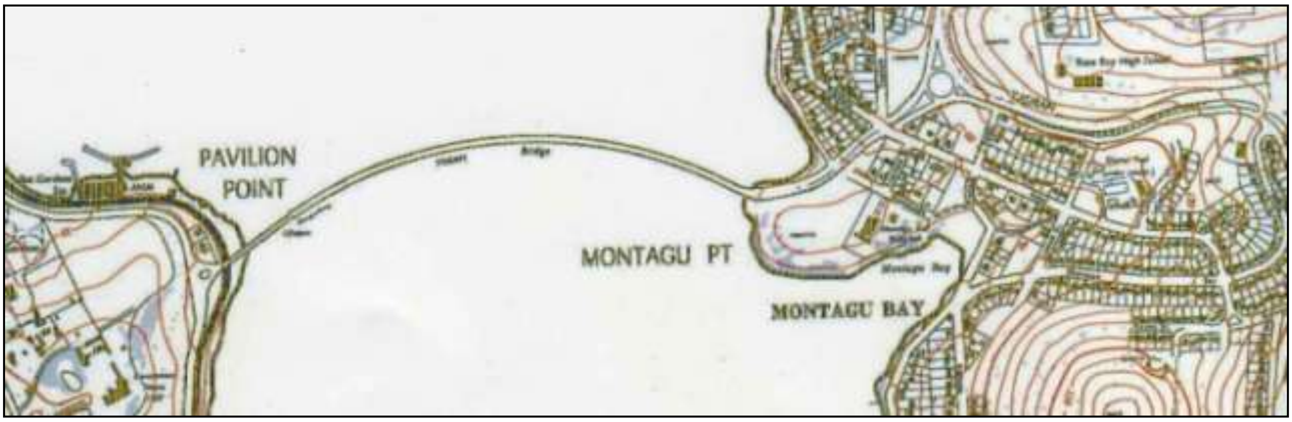
After 21 years of service, the two-lane floating bridge was removed and little evidence of this innovative structure remains. Its high level four-lane replacement immediately downstream opened in 1964.

A floating concrete bridge was the first affordable concept. Such bridges elsewhere were straight structures. Sideways pressures from winds, tides and currents were prevented from bending straight bridges by a series of midstream anchors both upstream and downstream. However trial anchors in the Derwent proved unreliable due to the great depth of water (down to 30m) and soft deep mud below that level.

Alan Knight realised that a curved alignment would not require midstream anchors. It would be strong as an arch when the tide flowed out and strong in tension (like a suspension bridge) when the flow reversed.

LOCATION MAP

The bridge was located between Pavilion Point on the western shore and Montagu Point on the eastern shore, about two kilometres upstream from the Hobart CBD. See Figure 1.



Lands Department

Figure 1: Location of Floating Bridge

HERITAGE AWARD NOMINATION FORM

The Administrator
Engineering Heritage Australia
Engineers Australia
Engineering House
11 National Circuit
BARTON ACT 2600

Name of work: HOBART'S FLOATING BRIDGE

The above-mentioned work is nominated for an

Engineering Heritage Award

Location, including address and map grid reference:

The bridge was removed in 1964. It previously spanned between Pavilion Point and Montagu Point about 2 km upstream from Hobart CBD.

MGA 526541E, 5252397N.

Owner (name & address):

Original owner	The Hobart Bridge Company.
Subsequent owner	Tasmanian Government
Responsible authority	Public Works Department

The owner has been advised of this proposal to nominate and a letter of agreement is attached.

Access to site:

The site of the western abutment can be reached along a side road off the Domain Highway opposite the Botanical Gardens. The foundation of a lift span tower can be seen above river level.

The eastern abutment is intact and can be reached from Topham Street, Rose Bay, almost under the Tasman Bridge.

Nominating Body: Engineering Heritage Tasmania.

Bruce Cole
Chair, Engineering Heritage Tasmania
Date: 15 March 2014

OWNER'S LETTER OF APPROVAL

Hon David O'Byrne MP
Minister for Economic Development
Minister for Science, Innovation and Technology
Minister for Infrastructure
Minister for Police and Emergency Management
Minister for Workplace Relations

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david.o'byrne@parliament.tas.gov.au

Tasmanian Government

11 NOV 2013

Mr Bruce Cole
Chair
Engineers Heritage Tasmania
Royal Engineers Building
2 Davey Street
HOBART TAS 7000

Dear Mr Cole

Thank you for your letter dated 5 November 2013 regarding the nomination for an engineering heritage award for Hobart Arch Bridge.

The Hobart Arch Bridge (Floating Bridge) was a significant structure for Tasmanians in the 1930s and had provided a useful link between the Eastern Shore and Hobart in the early days. The State Government and the Department of Infrastructure, Energy and Resources are supportive of the nomination and would be pleased to assist financially with the cost of refreshments and the interpretation panel at the award ceremony should the nomination be accepted by Engineers Australia.

I trust this information is of assistance to you.

Yours sincerely

David O'Byrne MP
Minister for Infrastructure

EARLIER PROPOSALS

Crossing the Derwent Estuary at Hobart originally involved man-powered boats, a hazardous exercise in rough weather. In 1855 the steam-powered twin-hull vessel *Kangaroo* was introduced, to be followed in 1927 by the vehicular ferry *Lurgurena* and a fleet of passenger ferries.

There were several early proposals for bridging the river, mostly located near Risdon where the river is narrower, several kilometres upstream of the final location. However the Derwent is both wide and deep, and those features presented a significant challenge to bridge engineers.

In 1824 Lieutenant Wm Jacob's proposed a military floating bridge consisting of a long line of boats, anchored both upstream and downstream, with a timber deck spanning between them. Figure 2 shows a cross section of the bridge of boats and a movable section which would allow ships to pass through.

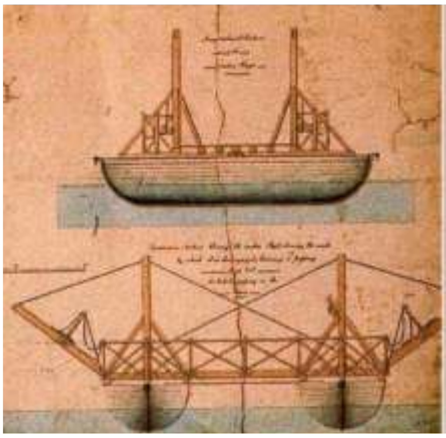

Figure 2: Floating bridge of boats

Tasmanian Archives & Heritage Office

In 1926 L Ennis of Dorman Long, working on the Sydney Harbour Bridge, suggested a transporter bridge, similar to one over the Tees River near his company's works. Figure 3 shows the concept. Vehicles are carried across the navigation span on a short deck suspended from an overhead gantry.

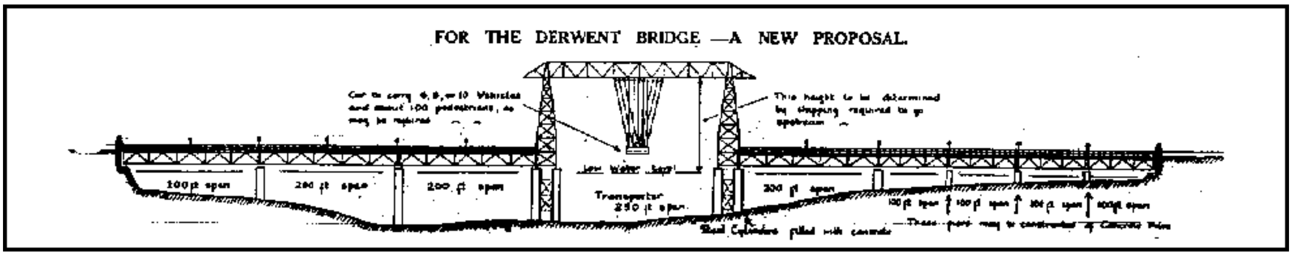

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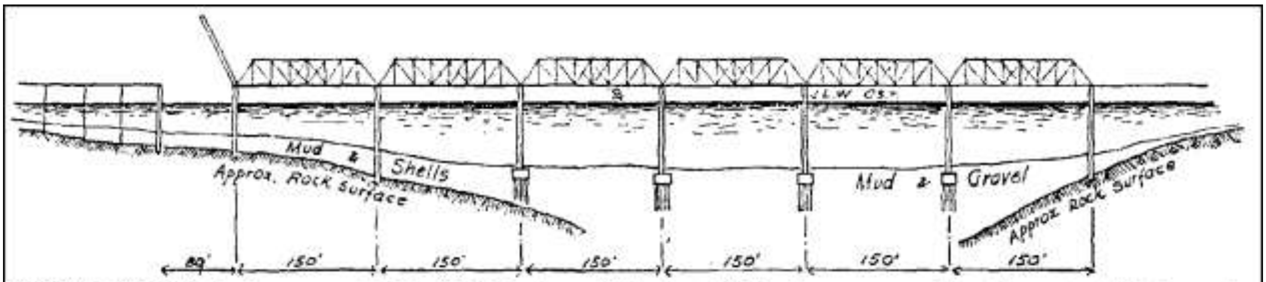
Figure 3: Transporter Bridge Proposal.

In 1930 J S Williams of Hobart proposed a straight concrete floating bridge of normal anchored design, i.e. anchored upstream and downstream to prevent bending.

In 1934 C T Stevens of the NSW Government was seconded to Tasmania and he recommended a low level steel truss bridge with a bascule opening for ships, at the Risdon Ferry site. See Figure 4. The drawing suggests that at least some investigation of the foundations had been carried out.



BASCULE BRIDGE of the type which Mr. C. T. Stephens, of New South Wales, has recommended as the most suitable for erectic over the river Derwent at Risdon Ferry site. He estimates its cost at £116,000. (See letterpress).

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Figure 4: Bascule Bridge Proposal

PROJECT PLANNING

A floating concrete bridge was the first affordable concept because it avoided the expense of constructing numerous piers down through 30 metres of water and a similar depth of mud.

Such bridges elsewhere were straight structures. Sideways pressures from winds, tides and currents were prevented from bending the bridges by the installation of a series of midstream anchors both upstream and downstream. However trial anchors in the Derwent proved unreliable due to the softness of the mud.

Alan Knight realised that a curved alignment would not require midstream anchors. The arch shape would be strong in compression when the tide flowed out and strong in tension (like a suspension bridge) when the flow reversed.

Local entrepreneur H S Barnett negotiated with the Government to get approval to build the bridge. Legislation was passed in 1936, authorising construction and for tolls to be charged to cover both capital and operating costs. Stan Barnett formed the Hobart Bridge Company Limited to finance the project and arranged insurance by the leading British marine insurance companies and Lloyds of London.

The designs, plans and specifications were produced by the Public Works Department (PWD) and the Director of Public Works was named as the Supervising Officer. In 1937 Alan Knight went to the USA to study bridge lift spans which were needed for both the Hobart and Bridgewater Bridges. David Isaacs, Consulting Engineer to the Department, was a significant contributor to the design.

CONSTRUCTION

Bridge components

From the Hobart end, the project consisted of a high level viaduct passing over the railway lines and then descending across a lift span to river level, to join the long floating arch stretching across to the eastern shore. Each end of the concrete arch was attached to an abutment by a large steel hinge which allowed for the 2m (6.5 ft) rise and fall of the tide.

The lift span for ship passage was suspended between two steel towers. The base of one tower formed the western abutment of the floating bridge. The eastern abutment was a small structure securely anchored to a circular trench cut into the rock on the shore. See cover photo.

The floating portion consisted of 24 reinforced concrete pontoons, joined in two groups of 12 to form two half arches each 480 m (1574 ft) long. Hinged on/off ramps connected the roadway to the pontoons which rose and fell with the tide.

Western approach spans

Under the agreement the PWD built the access roads to each end of the bridge. On the western shore the road passed over the railway line on a two-span reinforced concrete bridge. Four more concrete approach spans carried the roadway out to the lift span. The river piers were built inside timber cofferdams, and the concrete deck on timber pile falsework.

Contract awarded

After two years of investigation and design, a contract was awarded to the Timms Bridge Construction Pty Ltd for £310,000 in 1938. C D Timms was the manager of the company with F H Woods as Chief Engineer, later replaced G Leitch, The company established a comprehensive works area at Pavilion Point near the western abutment of the bridge, and began work in April 1938.

Supervision of construction was the responsibilty of the Public Works Department of which G D Balsille was Director, Alan Knight Chief Engineer, David Isaacs Consultant, Joe Slatter Resident Engineer, Charles Knight was Surveyor and Adam Clift Engineer.

Unfortunately, after three years work, the contractor became insolvent and withdrew in July 1941, due in part to tower foundation problems. The Hobart Bridge Company was then responsible for completing the work, probably with assistance from the Department's workforce, as some resources were transferred from the Bridgewater Bridge.

Lift span

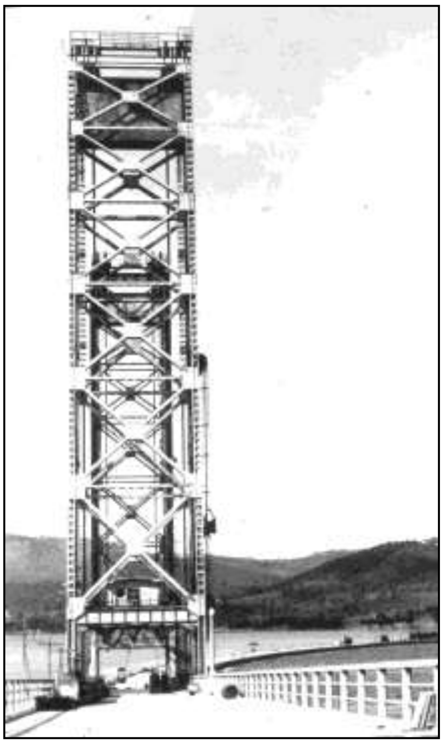
For the eastern tower, underwater excavation was carried out inside two 13m diameter cylindrical sheet pile caissons through mud and weathered rock until sound rock was found 37 metres (120 ft) below river level.

In the contract documents rock was expected at 27m (based on drilling) but that material turned out to be a band of cemented gravels which had to be broken through so that excavation could continue. The Tasmanian Government contributed £31,000 to cover the extra work.

Several divers suffered from the bends as they skimped on their decompression stops in order to let excavation work resume. This problem was solved when a compression chamber was fabricated from an old boiler.

When a satisfactory foundation was achieved, the first caisson was filled with concrete up to the top level of the mud and then excavation inside the second one was carried out. The concrete in the second caisson was joined to the first all the way up. Above mud level, the tower support was a single rectangular concrete column 10.6m by 14.8m poured inside precast concrete formwork.

In contrast, the western tower foundation consisted of four cylindrical columns built inside open circular concrete caissons 2.1m and 2.7m in diameter, one under each leg. Heavy concrete beams tied the four columns together at the tower base level.



Dennison Collection

Figure 5: Lift span tower

Each tower was 45m high (150 ft) and contained 280 tonnes of structural steel. The lift span weighed 350 tonnes. The contractor fabricated these large structures in his works area in sections. All the joints in the sections were welded while the field joints made during erection were riveted. See Figure 5.

The lift span weight was balanced by two concrete counterweights travelling up and down inside the towers. The balance varied through its travel due to the heavy counterweight ropes passing over the sheaves at the top of each tower. This variation was compensated for by two balance chains attached to the underside of each counterweight and hanging in a catenary to the point where they are fastened to the back legs of the tower.

The system was electrically operated by two 37 kW (50hp) motors and raising the lift span took less than 2 minutes. There were also auxiliary petrol engines in case of power failure. The bridge operators sitting in a small hut on the lift span gave ships priority over road traffic. Some dredging of the ship channel was required; the excavated material was dumped into

ancient timber hopper barges which "sank with heart-breaking regularity so that salvage became a routine operation after every heavy blow."

The navigation opening through the lift span was 55m (180 feet) wide and 44m (145'6") high.

Concrete pontoons

The pontoons were built at Pavilion Point on the western shore. Each pontoon was 40m long, 11m wide, 3.6m deep and weighed 1,000 tonnes. Internal concrete partitions supported the floor, walls and roadway, and provided 12 watertight compartments. The three open compartments at each end were sealed with temporary bulkheads to provide full buoyancy until the pontoons were joined.

Tasmanian Archives & Heritage Office

Figure 6: Launching a pontoon

On completion a pontoon was launched sideways down a timber slipway into the river. Each launch was a spectacular event which attracted public attention. See Figure 6. The first launch was a near disaster as the cradles stopped sliding short of floating level. Apparently the slipways had been greased too early and the crabs had eaten off the tallow. It was also found that the water was too shallow for the pontoon to float and all later launches were timed for mid-tide or above.

After launching, the pontoons were towed across to the shelter of Geilston Bay chosen because its shoreline matched the future curve of the half arches.

The ends of the pontoons were designed for joining on the water. They featured steel reinforcement protruding from the concrete and a concrete lip of similar protrusion across the bottom and up both sides. When two pontoons were brought together, a strip of sponge rubber placed by divers between the lips was compressed and formed a watertight seal. The space between the temporary bulkheads was then pumped out so that the reinforcement could be welded and concrete placed in the dry.

Adam Clift

Figure 7: Joining two pontoons

But spare a thought for surveyor Charles Knight who had to ensure that the pontoons were accurately aligned and levelled when his survey instrument was standing on a floating base. Steel girders fixed across the join ensured that the pontoons matched at roadway level, and heaps of sand were shovelled to positions to achieve a level draft. At times the workmen had to stand still to avoid disturbing the level, however slightly. Most of the work was carried out at night to avoid differential temperature effects, and when two sections of four pontoons had to be joined, the curvature of the earth became appreciable.

Figure 7 shows the placement of deck concrete after the reinforcement had been joined by welding.

Hinges at the ends

To cater for the tidal range of 2m, hinges were required at each end of the floating bridge, and the end pontoons were constructed with additional buoyancy to carry the extra weight of the connecting frame. The hinged frame was triangular in plan view, with two horizontal hinges at the pontoon end and one horizontal hinge and a vertical swivel at its apex, to accommodate vertical and rotational movements. See Figure 8.

Mercury Hobart

Figure 8: Hinged frames at abutments

Each hinge was bolted to the end pontoon with 50mm diameter steel bolts. Steel was difficult to obtain in wartime, and the contractor bought up all the 50mm rod that he could find. Some of the material was wrought iron and was rejected as unsuitable.

The connections between the hinges and the steel frame were arranged so that heavy steel pins could be lowered through matching holes once the end pontoon was in exactly the right position. On completion the hinged frames were hidden under roadway on/off ramps.

Installing the floating arches

The lift span had to be open for river traffic before the remainder of the river could be blocked by the floating arch.

Installing the two curved segments across the river required considerable planning and coordination. In preparation for placing the two 480m long arches across the river, a large buoy was securely anchored at mid-river. Steam-driven donkey engines were fixed on the pontoon decks to drive winches. As no tugs were available, a motley flotilla of eight steam vessels was assembled: the vehicular ferry Lurgurena (which the bridge replaced), two Navy mine sweepers, four river steamers and a hopper barge. All the captains were carefully briefed and systems of communications and signals established.

On 20th October 1943, with calm weather predicted, one arch was towed out on a falling tide and its midstream end was attached to the buoy. Operations were directed by Alan Knight. Next morning the second arch was similarly positioned; a launch was crushed between the arch and the buoy but nobody was hurt. Both half arches were then streaming downstream from the buoy, like two hands with palms facing.

Tasmanian Archives & Heritage Office

Figure 9: Driving pins at western connection

The next step was to tow the shore end of one arch in to the western abutment where, with the help of the ships and various winches, the connecting pins were

successfully inserted. The operation was repeated for the other half. See Figure 9.

The two mid-span ends were then brought together and the connection made with a single vertical pin through matching holes. That pin was 330 mm diameter and weighed half a tonne. See illustrations in Appendix A.

With that difficult task successfully completed, the final steps were to construct the on/off ramps at each end, and to build parapets along both sides of the bridge.

Severe storm before completion

The bridge was virtually complete when, on 4th December 1943, a ferocious storm occurred. Large waves travelled up the river and thundered into the bridge. See Figure 10. Parapet panels along the roadway were smashed and undulations were observed along the roadway as the bridge rode the waves. Measuring devices on the hinged connections at each end showed rapidly oscillating tension and compression. At the western end, four of the ten bolts attaching one hinge to the pontoon snapped. See Figure 11.

During the storm the Director of Public Works George Balsille thought the bridge would be lost, but the remaining bolts held. Tests showed the broken bolts to be of wrought iron, mistakenly accepted when sorting the wrought iron from the mild steel rods.

Dennison Collection

Figure 10: Storm in 1943

Dennison Collection

Figure 11: Hinge with broken bolts

After the storm, every pontoon had to be inspected. PWD engineers Max Linton and Fred Lakin well remember the tedious business of climbing up and over every internal partition, taking the ladders with them. Some hairline cracks were found in some pontoons, but mainly across the deck. These were sealed with bitumen. The few cracks below water level would either seal themselves or could be sealed with grout injection if necessary.

A short timber pile breakwater was installed on the downstream side of the westernmost pontoon to protect it from the next notorious “southerly buster”.

With help from the Melbourne Technical college, the PWD built a hydraulic model with a wave making machine in the rectangular reservoir beside Cascade Road. The impact of waves and the best position for a protective breakwater were investigated. As a result, a much longer timber breakwater was installed at mid-river and further downstream.

THE BRIDGE IN SERVICE

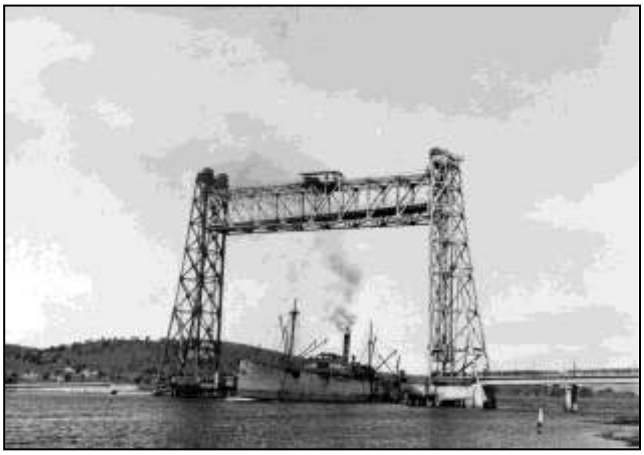
Opened on schedule

Despite the storm damage, the bridge was declared safe and opened to traffic on schedule on 22 December 1943, in time for the Christmas holidays.

The days of long queues waiting for the next crossing of the vehicular ferry *Lurgurena* were over. Vehicles using the bridge had to pay a toll. See Figure 12.

Dennison Collection

Figure 12: Toll booth c1943



Dennison Collection

Figure 13: Ship passing through lift span

Insurance payout

Because the bridge was a floating structure, it was insured as a ship by leading British Marine Insurance companies and by Lloyds of London. Following the storm, the Hobart Bridge Company Limited was paid an amount of £250,000 by the insurers in accordance with the terms of the insurance contract.

This payout helped the Government to acquire the bridge from the Hobart Bridge Company for a reasonable price in December 1944 and, under pressure from the travelling public, the toll was removed in December 1948. The Government also acquired land on the eastern shore.

Later episodes

One night the lift span operator heard a grinding noise and, when he investigated, he found the end of the floating bridge was almost submerged. Three fire engines were summoned to pump out the water. An inspection showed that some floating object had hit the bridge and caused a pontoon to leak, but only a minor repair was required.

A severe storm occurred in 1953, causing the bridge to be closed for the storm's duration, as the bridge was undulating and the roadway was drenched with salt water. Another storm in 1963 closed the bridge for a few hours.

End of life

Plans for a replacement bridge began about 1955 when the rapid growth in population on the eastern shore and beyond generated traffic volumes exceeding the capacity of the two-lane floating bridge. Given the periodic storm damage there were also concerns about the longevity of the bridge.

Its replacement was the four lane Tasman Bridge immediately downstream, a multi-span high level structure under which ships could pass without disrupting the traffic flow. See Figure A10 in Appendix A.

The day after the new bridge was opened in August 1964, the floating bridge was separated into its two halves. After years of discussion about whether further use could be made of the pontoons, one sixth was towed to Bruny Island to be a jetty at Alonnah and most of the remainder was sunk in deep water in Storm Bay. The lift span was removed and its steel towers demolished.

Today, only the eastern approach road remains, together with one concrete tower base still showing above river level and the 330mm diameter steel hinge pin, now on display outside the Royal Engineers Building in Hobart. See Figures 14 and 15.

Bruce Cole

Figure 14: Remaining tower base

Bruce Cole

Figure 15: Hinge Pin

Acknowledgement

Most of the historical information in this nomination and many of the photographs have been assiduously researched and collected by Allen Wilson over many years. He was a senior engineer in the Public Works Department and Mains Roads Department, and in retirement a member of Engineering Heritage Tasmania. He was not personally involved in any of the bridge works. He is a recipient of EHA’s Award of Merit for his contribution to the conservation of our engineering heritage.

BASIC DATA

Item Name:	Hobart's Floating Bridge
Location (grid reference):	MGA 526541 E 5252397 N
Address:	Derwent River, 2 km upstream of Hobart's CBD.
Suburb/Nearest Town:	City of Hobart
State:	Tasmania
Local Govt. Area:	Hobart City Council/Clarence Council
Owner:	Originally the Hobart Bridge Company Pty Ltd. Purchased by Tasmanian Government in 1948
Current Use:	Removed in 1964
Former Use:	Two lanes of road traffic across Derwent River
Designer:	Alan Knight, assisted by David Isaacs
Maker/Builder:	Timms Bridge Construction Company P/L and the Public Works Department
Year Started:	1938 **Year Completed**: 1943
Physical Description:	A two-lane viaduct over the railway line on the western shore. Two steel towers and a lift span for ship passage. 24 concrete pontoons joined into two half arches. A steel hinge at each end for anchorage and tidal movements A pinned joint at each end and between the two half arches
Physical Condition:	Not applicable.
Heritage Listings	None

HERITAGE ASSESSMENT

Historic phase

The first settlement of Hobart was at Risdon Cove on the eastern shore of the Derwent Estuary in 1803 but, the next year, it was moved to Sullivans Cove on the western shore. Crossing the river near Hobart was only possible by boat or ferry for the first 140 years. Ferries operated out of Sullivans Cove and at several locations further upstream.

The first bridge across the Derwent River was built in 1849 at Bridgewater, 22 km upstream from Hobart, on the main road to Launceston.

The transport of vehicles across the river at Hobart began in 1855 with *SPKangaroo* which was the first steamship built in Tasmania specifically for use as a vehicular ferry. This twin-hulled paddle steamer operated between Hobart and Bellerive until 1926. She was replaced by the much larger *SSLurgurena* which carried vehicles across the Derwent until the Floating Bridge was completed in 1943.

The two-lane Floating Bridge brought to an end the long queues at peak times of vehicles waiting for the next ferry crossing or the one after that. The bridge provided an essential service for 21 years until superseded by the four-lane high-level Tasman Bridge which opened in 1964.

Historic individuals or associations

Sir Alan Knight

Alan Knight became one of Tasmania's greatest engineers. He joined the Tasmanian Public works Department in 1932 as a bridge design engineer. He pioneered composite bridges in which the concrete deck is anchored to the supporting steel beams to give additional strength at less cost. He was appointed Chief Engineer in 1936, aged 26. In 1936 he travelled to the USA to investigate bridge lift spans for river traffic. Lift spans were needed for both the Floating Bridge and the Bridgewater Bridge.

In 1946 He was appointed Commissioner of the Hydro-Electric Commission which was responsible for not only power development but also transmission, distribution and retail sales. He oversaw the development of Tasmania's considerable hydro-electric resources for the next 30 years.

Alan Knight is credited with the concept and overall design of the floating bridge and patented it. He personally directed the critical operation of installing the two half arches across the river. David Isaacs of Melbourne also made a significant contribution to the design as consultant to the Public Works Department.

HEC

Figure 16:
Sir Alan Knight

H S Barnett

Stan Barnett was a visionary developer who had faith in the engineering ability of Alan Knight and his department to produce a successful design. He formed a company and raised the capital to build the floating bridge, expecting to recoup his investment from toll charges and the appreciation of land values on the eastern shore after the bridge was built.

Tasmania Government

The Government under Premier Albert Ogilvie passed the legislation for the project. It also made a financial contribution when the tower foundation needed to be carried down 10m deeper than expected. After five years of toll charges, the Government purchased the bridge and removed the tolls.

Creative or technical achievement

The floating arch bridge was a highly innovative solution to a long-standing engineering challenge, at a price which a developer considered viable.

It overcame the difficulty and cost of constructing multiple piers in deep water and soft mud.

It avoided the problem of trying to establish reliable anchors in the river bed.

It suffered only minor damage in several severe storms. The waves not only exerted impacts on striking the pontoons, but they also produced visible vertical undulations in the roadway as they passed under the structure. The forces and stresses under storm conditions would not have been easily assessed.

It was built during World War II when both labour and materials were in short supply.

Research potential

After the severe storm in 1954, a hydraulic model was built in a South Hobart reservoir with a wave-making machine. It may have resulted in the construction of the second breakwater, but details of the tests and their outcomes have not been found.

It is not certain how the bridge was completed after the contractor became insolvent and retired. The Hobart Bridge statistics on the Tasmanian Parliamentary website state that the Hobart Bridge Company carried out the work, but engineer Adam Clift, who worked on the bridge construction said that the Public Works Department finished the job.

The research presented in Appendix B suggests that using the strength of an arch to avoid mid-stream anchors was not adopted elsewhere until the 1990s and even then the actual design was quite different. It seems highly likely that this curved floating bridge was the only one in the world with continuous concrete pontoons, but it would be great to have this assumption confirmed.

The extent to which David Isaacs contributed to the design is uncertain. For the lift span of the Bridgewater Bridge being built at the same time, he is credited with designing weld details which have successfully resisted fatigue cracking for over 70 years.

Social benefits

It enabled a continuous flow of traffic across the Derwent estuary for 21 years and led to the rapid development of residential land on the eastern shore. In 1943 the population on the eastern shore was less than 5000; by 1964 when the bridge closed, the population was over 30,000.

The journey to Hobart's airport requires the crossing of the river and a further 15km eastward to Cambridge. No longer would passengers be stuck in a ferry queue wondering of they would reach the airport in time.

Bellerive and Lindisfarne were essentially residential suburbs which relied upon the essential services in Hobart's CBD at the time. The bridge gave eastern shore residents ready access to large shops, government offices, hospitals, banks etc for many years.

Rarity

As mentioned earlier it seems likely that the floating bridge is the only curved floating bridge in the world.

Representativeness

Apart from its important curved alignment, the other features of the bridge are representative of its type, namely: the hinges at each end to allow for the rise and fall of the tide, the lift span for the passage of ships and perhaps the overhangs on the pontoon sides to deflect waves.

Integrity/Intactness

Sadly the bridge was removed in 1964 when its four lane (later 5 lane) replacement was completed. By that time the pontoons had developed some cracking and its capacity was no longer adequate for the increased traffic.

Statement of significance

The floating bridge was the first affordable design for crossing of the Derwent Estuary at Hobart. It avoided the high cost of multiple piers constructed in deep water and the deep mud of the river bed. The curved alignment eliminated the need for midstream anchors essential for restraining straight floating bridges built elsewhere. The two lane bridge served the greater Hobart area for 21 years. It allowed traffic to flow continuously, removed reliance on a vehicular ferry and facilitated the rapid expansion of residential suburbs on the eastern shore.

Level of significance

At least National.

INTERPRETATION PLAN

Interpretation Panel Title: HOBART'S FLOATING BRIDGE

Proposed themes

1. Lift span and divers

The foundations for the two towers were excavated inside circular steel caissons all the way down through the water, soft mud and cemented gravels to sound rock. Divers were required to inspect the rock and carry out surface clean up before the caissons were filled with concrete. Some of the divers suffered from the bends until the contractor fabricated an on-site decompression chamber.

The towers and lift span were fabricated with 910 tonnes of steel. When a ship approached, the operator closed the road, climbed up to the control cabin and raised the span in two minutes.

2. Pontoons

The reinforced concrete pontoons weighed 1000 tonnes. They were built on a slipway and each launch was a spectacular public event advertised in the newspaper. (See photo ?).

3. Installation

The towing of the two half arches out of Geilston Bay and across the river, their anchoring to each abutment and connection at mid river was a huge logistical operation. With no tugs available a motley collection of six local vessels including the vehicular ferry *Lurgurena* was assembled, and the skippers were given detailed instructions. Calm weather held and the operation went smoothly. (Photo of floating arch and *Lurgurena*)

4. Sir Alan Knight

Chief Engineer of the Public works Department. The floating bridge was his concept and he was responsible for the design

5. In service

A severe storm on 4 December 1943 did not prevent the bridge opening on schedule 24 December 1943. Tolls were charged for five years. They were removed when the Government purchased the bridge in 1948. It gave 21 years of good service until the Tasman Bridge replaced it in 1964. (Photos of toll booth and storm)

Locations

As the bridge connected the City of Hobart with the Municipality of Clarence, it is proposed to install a marker and panel on each shore close to the original bridge abutments.

On the western shore there is a convenient grassy area where a cycle path leads up onto the Tasman Bridge. Beside the domain Highway which passes under the Tasman Bridge near this spot, there is parking area where motorists can easily stop, get out and read the panel. See Figure 17.

Bruce Cole

Figure 17: Western panel site

On the eastern shore the original floating bridge abutment is still in existence, near a large Tasman Bridge pier. It may be possible to install the panel on a steel frame on the water side of the abutment just out of reach of vandals and spray cans. See Figure 18.

Source unknown

Figure 18: Eastern end in service

Bruce Cole

Figure 19: Eastern panel

Meeting the cost

While the Department of Infrastructure has agreed to help meet the cost, it is intended to invite both Councils to take part in this project and hopefully contribute to the cost of the panels and their installation.

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"Mega Floating Concrete Bridges". Masters Thesis by Ali Halim Saleh, TU Delft, 23 August 2010. See www.superfloats.com/floatingstructures

Top 10 longest floating bridges in the world

The Mercury (1941) Saturday 5 July, front page.

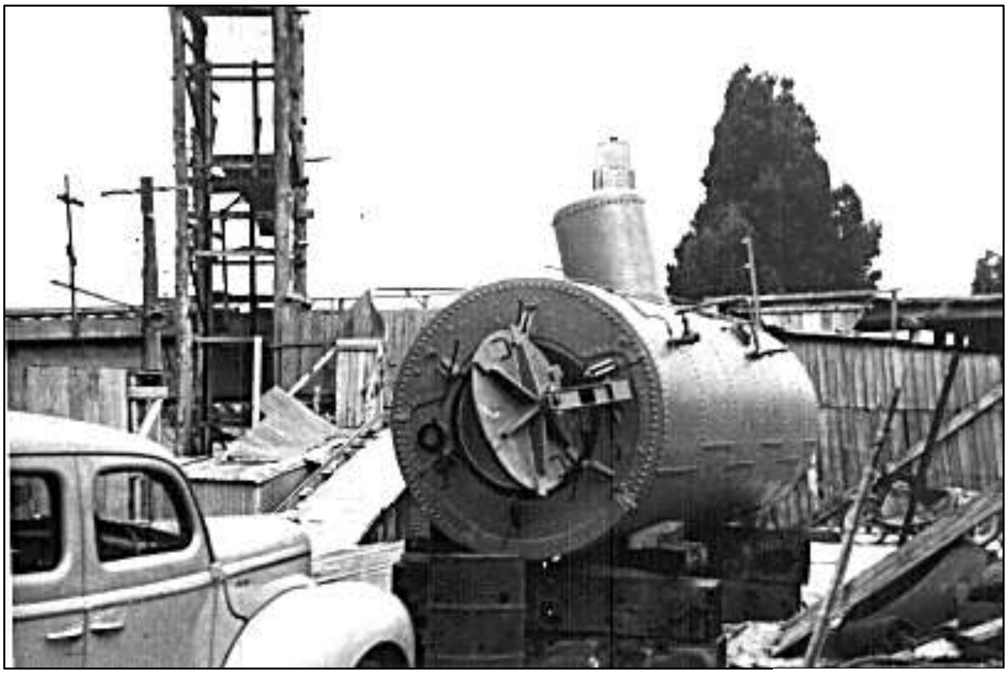
The Mercury (1927) Figure 2, 17 February; (1934) Figure 3, 14 August.

www.graphs.net/top-10-longest-floating-bridges-in-the-world-infographic.html

APPENDIX A ADDITIONAL ILLUSTRATIONS

Barnett photo

Figure A1: Divers and attendants



Adam Clift photo?

Figure A2: Decompression chamber made from old boiler

Adam Clift

Figure A3: Keeping pontoons level with strongbacks before joining

Tasmanian Archives & Heritage Office

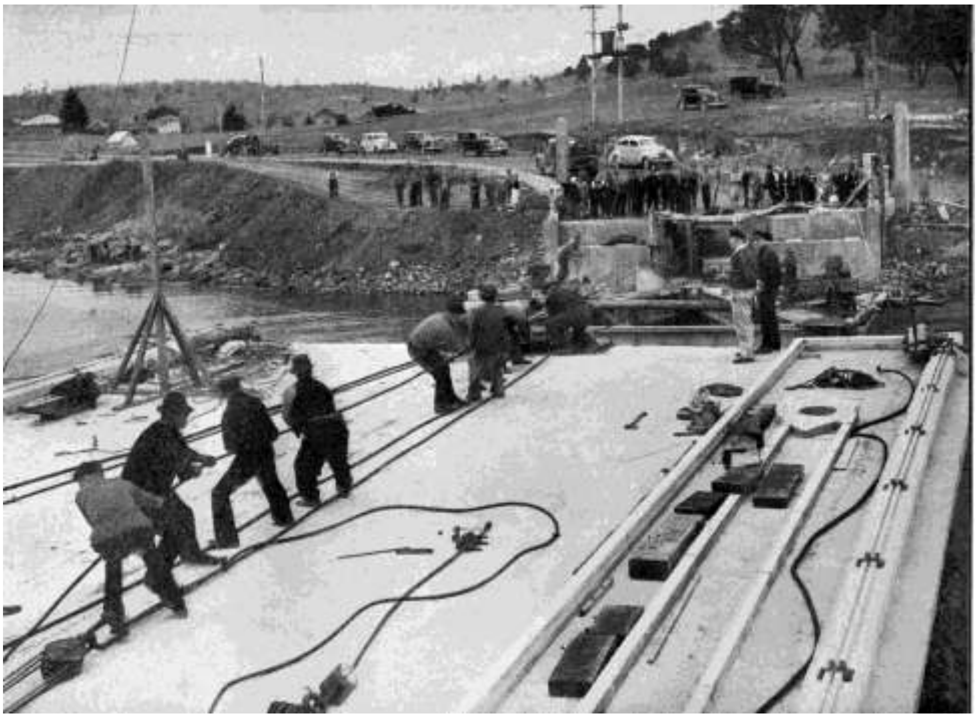
Figure A4: Two half arches in Geilston Bay, one ready for towing out.

Dennison Collection

Figure A5: Mid-river anchor for bridge assembly

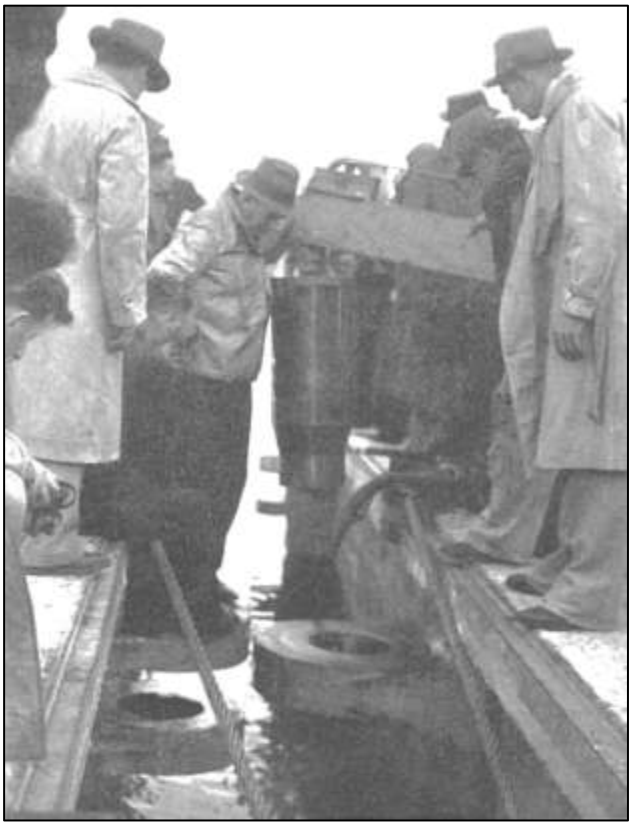
Tasmanian Archives & Heritage Office

Figure A6: *SS Lurgurena*, vehicular ferry, on towing duty



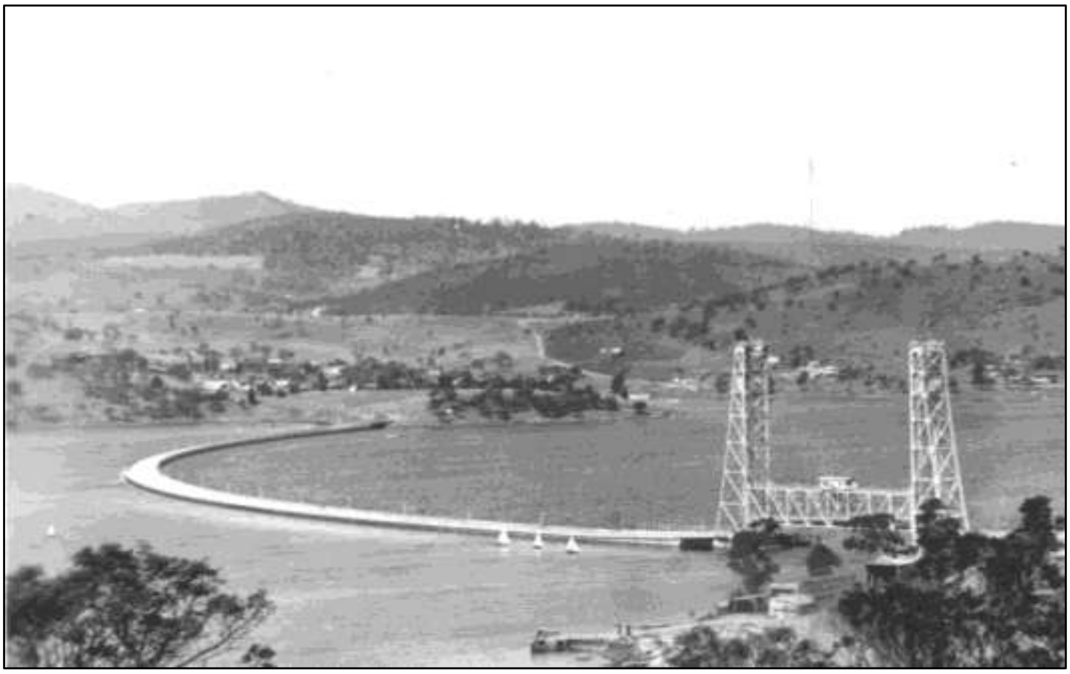
Tasmanian Archives & Heritage Office

Figure A7: Connecting to eastern abutment



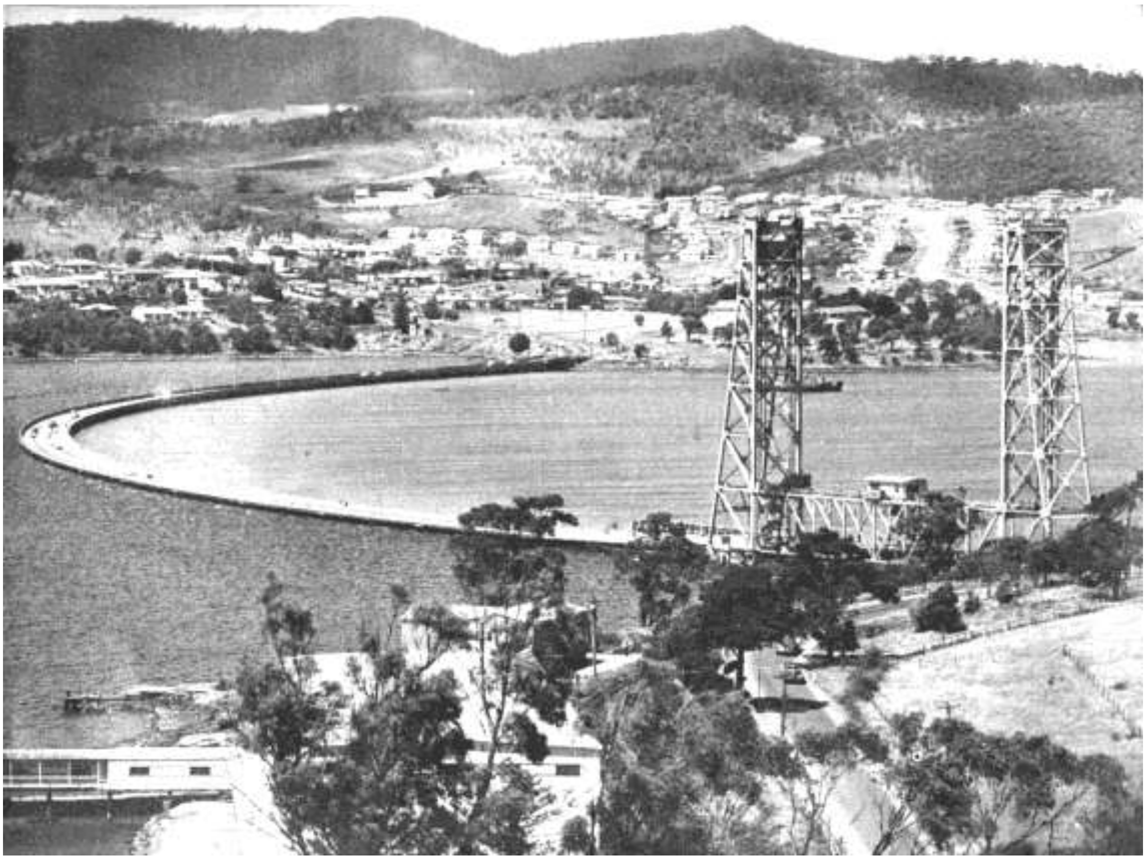
Dennison Collection

Figure A8: The pin ready to join the two half arches



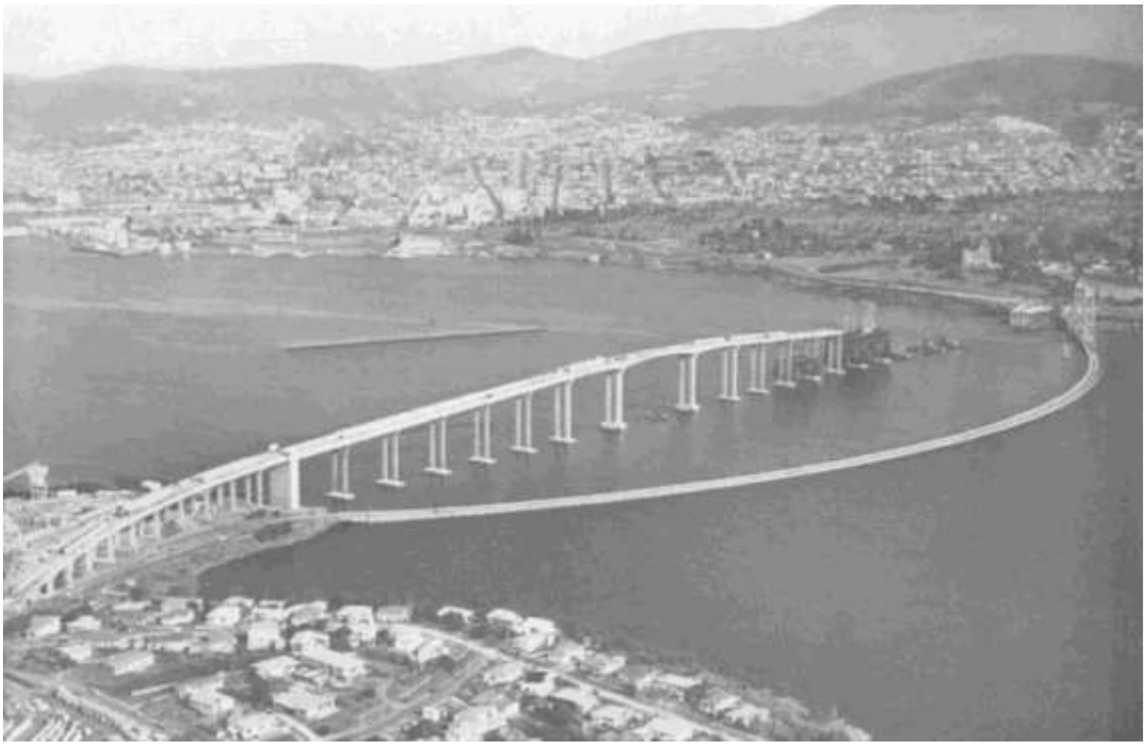
Dennison Collection

Figure A9: Bridge complete; few houses on eastern shore



Dennison Collection

Figure A10: Many houses on eastern shore



Hobart Mercury

Figure A11: Tasman Bridge nearing completion

APPENDIX B OTHER FLOATING BRIDGES

1. "**Mega Floating Concrete Bridges**". Masters Thesis by Ali Halim Saleh, TU Delft, 23 August 2010. See www.superfloats.com/floatingstructures

In his thesis Ali Selah lists 15 floating bridges in seven different countries and includes photographs of many of them. See the table in three parts below.

Only two bridges preceded Hobart's.

One is the Galata Floating Bridge (No. 1) in Istanbul, built in 1912 with steel pontoons. The photo below shows it to be a straight double-decker bridge with six traffic lanes on top and continuous shops below. It was damaged by fire and towed away in 1992 to make way for a replacement.

The other is the Lacey V Murrow Bridge (No.2) in Washington State, USA built in 1940. The photo in the report shows it was a straight bridge. (It was damaged during modifications and sank in 1990. It was being replaced in 2010, traffic being carried on a parallel floating bridge built in 1989.)

Table (1-1)
Major Floating Bridges around the World
Translated from the *guideline for design of floating brides*
Japan society of civil engineers, March 2006 p.8 [ref.18]

No.	Year	Name	Location	Deep-est (m)	Leng-th (m)	Pontoon dimensions (m)
1	1912	Galata	Istanbul, Turkey(River mouth)	41	466	25x9x3.7
2	1940	Lacey V Murrow	Washington State, USA(Lake)	75	2,018	107x18x4.4
3	1943	Hobart	Tasmania, Australia(River mouth)	31	965	40x11x3.7
4	1957	Kelowna	British Columbia, Canada (Lake)	49	640	61x15x4.6
5	1961	Hood Canal Old (east side)	Washington State, USA(Lake)	104	1,972	110x15x4.4
6	1963	Evergreen point	Washington State, USA(Lake)	61	2,310	110x18x4.5
7	1983	Hood Canal new (west side)	Washington State, USA(Lake)	104	1,972	110x18x5.5
8	1989	Third Lake Washington	Washington State, USA(Lake)	61	1,771	108x23x5.0
9	1992	Bergsoysund	Kristiansund, Norway(Fjord)	300	934	34x20x6.0
10	1994	Nordhordland	Bergen, Norway (Fjord)	500	1,246	42x12.5x6.8
11	1996	West India Quay Foot Bridge	London, England (River mouth)		94	Φ 2.8x10
12	1996	Nagoya Fish Port Terminal	Nagoya, Saga, Japan(Inner Harbor)	10	110	110x15x3.0
13	1998	Admiral Clarey	Hawaii, USA (Inner Harbor)	15	310	93x15x5.1
14	2000	Kujira	Nishino Omote, Kagoshima(Lake)		180	
15	2000	Mumai Oohashi	Osaka (Inner Harbor)	10	410	58x58x8.0

No.	Natural Condition					Lanes	Pontoon structure material	Methods of restraint
	Water level change(m)	High wave force Hs(m)	Wave cycle Ts(sec)	Flow (m/sec)	Wind speed(m/sec)			
1	0.6			3.0		4	Steel	Chain/Anchor
2	1.2	2.4	4.0		28	4	Concrete	Cable/Anchor
3	2.4	2.1		1.5	55	2	Concrete	Fixed end
4	1.5	1.8				2	Concrete	Chain/Anchor
5	5.0	3.3		1.5	37	2	Concrete	Cable/Anchor
6	1.2	2.7			38	4	Concrete	Cable/Anchor
7	5.0	3.3		1.5	37	2	Concrete	Cable/Anchor
8	1.2	2.4	4.6		28	5	Concrete	Cable/Anchor
9	4.0	1.4	4.5	1.3	37.5	2	Concrete	Fixed end
10	3.0	1.7	5.1		27.1	2	Concrete	Fixed end
11							Steel	Cable/Anchor
12						2	PC Hybrid	Jacket
13						2	Concrete	Chain/Anchor
14				0.3			Aluminium	
15	2.0	2.5	7.7	0.3	42	4	Steel	Fender/Dolphin

No.	Notes
1	Used until 1992, then demolished and new non-floating bridge
2	Replaced some pontoons in 1990 due to damage by disaster
3	Used until 1964, then non-floating bridge. Reusing the concrete pontoons as break-water
4	Rebuilding began in 2005, and estimated completion in 2008
5	Rebuilding began in 2003, and estimated completion in 2007
6	Rebuilding began in 2007
7	Due to damage by disaster, rebuilt the west side only in 1979
8	
9	
10	
11	Foot bridge
12	Pier/ road dual use
13	Military only and not for public
14	
15	

The Hobart Bridge is listed as No. 3. Whereas most of the others are anchored by cables, the Hobart Bridge is shown as having "fixed ends" which means that each end is attached to an abutment but there are no intermediate anchors.

Kelowna Floating Bridge (No.4) built in 1957 in Canada is also a straight bridge.

The concept of a curved arch to avoid anchors was adopted for two floating bridges in Norway.

The Bergsoysund Bridge (No.9) built in 1992 consists of a line of individual pontoons which support a continuous steel truss superstructure which spans the full length of the bridge and carries the traffic. The superstructure is attached to each abutment and forms the arch. See photo below.

The Nordhordland Bridge (No.10) built in 1994 is similar. The curved superstructure is continuous concrete box girder which also forms the bridge deck. See photo below.

The water depth of 300m and 500m for these two bridges put midstream anchors out of contention.

Galata Bridge, Istanbul in 1984

structurae.net

Lacey V Murrow Bridge on the right

structurae.net

Begsoysund Bridge

structurae.net

Nordhordland Bridge structurae.net

2. Top 10 longest floating bridges in the world

The 10 images appear on a Google search of this title and include those pictured above. Hobart's Floating Bridge is the seventh longest. While the length is correct, the image is of its replacement, the Tasman Bridge.

3. Conclusion

From the evidence so far uncovered,

- the concept of using a structural floating arch to avoid riverbed anchors was not adopted elsewhere for another 50 years;
- the concept when applied in Norway was applied differently; it used separate pontoons to support the structural arch which carried the traffic; and
- there appears to be no other bridge quite the same as Hobart's Floating Bridge where the three-pinned arch consisted of continuous concrete pontoons with the traffic travelling on their upper surface.